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A COLLAR DISEASE OF RUBBER SEEDLINGS.

By A. Sharples.

AN interesting disease of basket seedlings of Rubber has been studied recently. The writer has only once previously, in 1914, seen this disease in Malaya.

The prominent fungus in both cases was the common *Diplodia* sp., responsible for the "Die-back" of Rubber branches. The stems of seedlings which were 9 inches to 1 foot in height were attacked at the collar, about ground level. The cortical tissues were first attacked for about 1" above the ground; later the whole of the stem tissues over this area become involved, and the head of leaves finally falls over.

A similar disease has been reported from Java and Ceylon. The description given by Petch (2) corresponds closely with the symptoms observed in Malaya, but the causal fungus is given as *Pestallozzia palmarum* (Cke). No trace of *P. palmarum* (Cke.) was found in the diseased Malayan seedlings, but both fungi, i.e. *Diplodia* sp., and *P. palmarum* (Cke.) are, in general, but weakly parasitic, so that it is probable that either fungus could bring about almost similar symptoms.

The disease in Ceylon was found in nursery beds and as Petch points out (l.c.) the same ground is often continuously used for nurseries and consequently the soil becomes sour and quite unfit for use in nursery beds. Such conditions favour the development of weakly seedlings which are unable to resist the attacks of weakly parasitic fungi.

In both cases observed in Malaya, the seedlings were in baskets, so that the soil was used once only. Large, permanent, adjoining nurseries, with ordinary seedlings for stumps, were free or had only a few cases of the disease, as compared with the basket seedlings.

A careful inspection of the beds in which the basket seedlings were growing showed, in only one single case, a heavy infection

before planting. The remaining beds of basket seedlings in other situations were quite free.

There seems little doubt that the heavy infection in certain fields was primarily due to the planting of seedlings obtained from a previously infected bed. The writer is of the opinion, however, that a considerable number of seedlings first showed definite signs of infection in the fields and that considerations such as soil sourness enabling a weakly parasitic fungus to attack weakly individuals will not account for the whole of the symptoms observed.

Butler (1) calls attention to a somewhat similar disease on Tea seedlings and though no parasite has been found in connection with the disease in India, yet in Java and Ceylon, a fungus has been found in the diseased parts. Both in Java and India, the original cause of this disease has been assigned to alternations of high humidity and great heat. The conditions were most closely examined in India, and it was found that the disease (i.e. on Tea seedlings) occurred in a season in which there was, first a long drought with considerable heat towards the end, then, continuous heavy rain for about a fortnight, and, then several extremely hot days. During these, the disease became evident. The whole trouble was attributed to climatic changes in India, but in Java and Ceylon, the fungus present is considered to be the direct cause, Java opinion holding, in addition, that abrupt climatic changes prepare the way for the attack.

Steinmann (3) in his recent book describes a disease showing very similar symptons. This author evidently has not met with the disease except in nursery beds where he says it "occurs sporadically only", and has been erroneously attributed to *P. palmarum*. He also points out that fungi of the genera *Phoma*, *Colletotrichum* and also *Diplodia*, have been found associated with the affection, but proved to be secondary.

The most important difference between the description given by Steinmann (l.c.) and that observed in Malaya, is that in Java "in exceptional cases only the young plants die off completely," while in this country, the exact opposite is found, i.e. that practically no recoveries can be recorded. The concensus of opinion appears to be that a purely physical cause is to be regarded as primary, viz. "excessive heating by solar heat", and that the fungus is purely secondary and often superficial. While no definite work in the shape of isolations or inoculations was undertaken, the writer, while agreeing with the view that the primary cause is scorching, is inclined to attach more importance to the effects produced by the fungus, than Steinmann.

Steinmann says "the cause of the disease (i.e. in Java), as a rule, is that the seedlings have been planted too far down in the ground, so that that part of the stem which is still green and not yet protected by cork in the bark against external influences, is brought into contact with the hot upper layer of the greatly heated soil surface and is scorched by it. "This quotation obviously cannot apply to

the conditions in this last Malayan outbreak, where large numbers of diseased seedlings were found which had grown naturally from selected seed, and had not been removed from the nurseries.

Abrupt changes in climatic conditions, combined with the presence of a fungus, may possibly account for the latest Malayan attack. The disease appeared during a hot dry period in December, rather unusual weather for Malaya at this time of the year. Watering, two or three times daily was being undertaken, and in the writer's opinion, the soil in the baskets containing the diseased seedlings was being kept much too wet. Such conditions would probably result in producing a state in the host plant, which would favour the entry of such a fungus as the *Diplodia* sp. under consideration.

Treatment was advised in the report as follows:—

Nursery beds containing few diseased seedlings, were to be removed carefully from the vicinity of the heavily infected bed. When removal was complete, after thorough inspection of lifted plants to prevent leakage of diseased plants, the heavily infected bed was to be treated. All diseased plants in this bed were to be lifted and immersed in a receptacle containing 5% Izal. After thorough immersion for a minute or two, the plants were to be placed in a box prior to removal for burning. A count had to be kept, as far as possible, to obtain some idea of percentage infection. After this treatment, a second inspection was to be made ten days later and diseased plants removed as before, and a count again taken. If the percentage infection decreases considerably no further treatment is required. It was recommended that no watering of the bed should be undertaken, except in case of wilting owing to prolonged dry weather.

Owing to the absence of a Resident Manager on the estate the above scheme would have taken some time to put into operation. In order to expedite control arrangements, the Manager decided immediately to spray the badly diseased bed with 5% Izal. The result of this spraying was that all badly diseased plants died, while the healthy ones survived. On this result, lightly infected nursery beds were subjected to the same treatment and no losses of healthy plants are to be reported.

Although in this case, spraying with 5% Izal does not appear to have done damage to healthy seedlings, the writer would urge caution regarding the use of more than a 2½% solution, for cases of burning have been observed, using stronger solutions.

Treatment in the fields which showed numerous diseased plants has to be considered in relation to the possibility of the soil becoming infected with the spores of the fungus in the neighbourhood of diseased plants; healthy supplies might then become infected fairly quickly. To remove diseased plants, the baskets and soil containing the plants were lifted carefully and taken away for burning. The

soil about the hole was opened up and lightly sprinkled with lime. The ground was allowed to remain open for not less than a week, when the lime was well mixed with the soil before resupplying.

The above measures were completely successful and the disease has now disappeared.

(1) Butler, E. J. ... Fungi and Disease in Plants, 1918. Page 464. Thacker, Spink & Co., Calcutta and Simla.

(2) Petch, T. .. The Diseases and Pests of the Rubber Tree, 1921. Page 163. Macmillan & Co., Ltd., London.

(3) Steinmann, A. ... Diseases and Pests of *Hevea brasiliensis* in the Dutch-East-Indies, Page 73–75, (Dutch Text).

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STUDIES ON HEVEA LATEX.

III. Proteins and Allied Bodies.

By W. N. C. Belgrave.

IN continuation of former studies on latex constituents[1] work has been carried out on the manner in which the protein nitrogen in latex is distributed. Owing to the peculiar difficultjes presented by Hevea latex the results are unsatisfactory and incomplete, but it is felt that they may serve as a guide to future work, and are therefore placed on record.

At the outset it must be realised that any study of distribution based on results obtained after coagulation* will give a true picture of the distribution actually existing only in so far as change at the time of coagulation is avoided.

Bacterial action may be avoided by adding sufficient acid (2% of 10% acetic) to bring about rapid coagulation and then warming slightly (not above 45° C) to ensure rapid and clear separation of serum. By this means the whole operation can be completed in one hour from the time of collection. The weak acid present is unlikely to bring about hydrolysis to any serious extent. There remains the question of the action of proteolytic enzymes. So far unlike many other latices no such enzyme has been recorded in Hevea latex, and the writer, as a result of experiments to be described later, is satisfied that no enzyme exists in latex active enough to bring about serious changes in the composition of the nitrogen bodies within the time limits of the experiments which follow.

Qualitative.

On coagulation of latex it is well known [1, 3] that part of the N is taken down by the coagulum, while of the remainder left in the serum part is accounted for by a heat coagulable protein (which may also be obtained on neutralisation.) Heating at the neutral point causes no further precipitation and therefore meta-proteins must be taken to be absent. Half saturation of the serum with ammonium sulphate gives no precipitate but full saturation does; according to the usual classification, the body precipitated is a secondary albumose. There remain amides and amino-acids which may be demonstrated in the usual way.

Quantitative.

Following the methods which Osborne and others [4, 5] have applied to the proteins of alfalfa—the following procedure was adopted :—

(*a*) After rapid coagulation as described above the rubber was passed without washing through a creping machine and the serum collected.

*The writer has, unlike Hauser,[2] been unable to obtain satisfactory filtration of latex through ceramic or other filters—unfortunately Hauser has not given details of his filters.

(*b*) The crepe from (a) was soaked in 95% alcohol for 5 minutes then recreped, the alcoholic liquor being repeatedly poured over the rolls.

(*c*) The crepe from (b) was soaked in .3% aqueous Na OH and treated as above.

(*d*) The crepe from (c) was heated for 5 minutes with 3% alcoholic Na OH and after cooling was treated as above.

The first aqueous serum was then mixed with an equal volume of 95% alcohol and the precipitate after settling collected and washed. Lead acetate was added and after removal of the precipitate of albumoses etc., mercuric acetate and sodium carbonate after the method of Neuberg to precipitate amino-acids. The lead and mercury precipitates were decomposed in the usual manner with H_2SO_4 and H_2S respectively.

Kjeldahl determination gave the following results :—

TABLE I.

2000ccs latex (approx. D.R.C. 40%) containing 5.49 grs. nitrogen = 0.27 %N.

			% of total N. in latex.
Total Nitrogen in 1st serum.	1.6	grs.	33.4
„ „ 2nd „ (cold alcohol)	.08	„	1.6
„ „ 3rd „ „ aq. soda)	.25	„	4.6
„ „ 4th „ (hot alc. soda)	.26	„	4.8
Nitrogen in rubber after above treatment	2 5	„	46.3

Evidently the subsequent extractions in the case of rubber do not remove any significant quantity of material—the method was therefore discarded.

Aqueous Serum—(*a*)

Four successive lots were treated and gave results shown below :—

TABLE II.

	I.		II.		III.		IV.	
Vol. of latex. ccs.	2000		3000		3000		8,600.	
	grs.	% on latex.	grs.	% on latex.	grs.	% on latex.	grs.	% on latex.
N. content of latex.	5.4	0.27	8.0	.266	7.8	.26	22.4	.26
„ in aq. serum	1.6	33.4	2.7	33.6	2 5	32.0	7.41	33.1
	of N. in Serum		% of N. in Serum		% of N. in Serum		% of N. in Serum	
„ „ alc. coag. protein :	0.06	3.8	0.11	4.1	0.09	.36	0.382	5.14
„ „ Pb.Ac.ppt.	0.133	8.3	0.42	15.6	0.36	14.4	1.05	14.1
„ „ Hg.Ac.ppt.	0.5	31.2	0.47	17.4	0.53	21.2	1.97	26.4
Residual N.			0.8	29.7			2.3	39.8
				66.7				76.0

*Precipitation with acid Hg. Cl_2 after Hg. Ac. gave negligible quantities of ppt.

With the exception of sample 1 in which precipitation with Pb Ac was apparently incomplete, the figures appear to be within the limits of the large experimental error due to dealing with small initial quantities of somewhat indefinite substances.

Taking as a working figure the nitrogen in serum to be 33% of total, distributed-protein 4% albumoses 14% amino-acids, amides etc. 20% and the whole of the residual nitrogen in rubber treated as in Table I to have been in protein form we have on the original latex.

	%	% of total N. in latex.
Protein -	47.3	say 50
Albumoses -	4.6	„ 5
Amino acids etc. -	6.6	„ 7
Nitrogen extracted by alcohol and alkali and not further determined -	10	„ 10
		72%

The figures, approximate as they are, show what might be expected in the normal course of protein metabolism and do not indicate any special function for the lower products.

The latex used was obtained from mature trees at different periods under different system of tapping—no variations were noted which could be assigned to differences in tapping systems.

The Constitution of the Proteins and Derivatives.

The difficulties encountered in separating and purifying large quantities of protein from serum together with the lack of certainty that a limited number of hydrolyses can give accurate information as to constitution* put out of consideration any attempt at separation and estimation of the component amino-acids of original protein. All that has been attempted has been, a rough separation into large groups and no claim is made that accuracy has been achieved even in this. The main object of the work, however, was to obtain results which could enable a very broad comparison to be made with other proteins—and to say for example whether latex protein contains a large amount of non-amino nitrogen like gliadine—or a high diamino content like protamines.

After a number of standard methods of separation had been tried, with unpromising results, resort was made to the recently published carbamate method of Kingston and Schryver[6] which appeared to be applicable to small quantities†. For details reference should be made to the original. The essential points of the process

* See in this connection the variable results possible with even very highly purified gelatine—Knaggs and Schryver-Investigations on gelatine VIII Biochem. Joun. No. 5, p. 1106.

† It should be noted that Kingston and Schryver do not claim that this process, in its present form, is complete.

are—the protein is hydrolysed with sulphuric acid, the excess of acid (and humin nitrogen) is removed with baryta—the dicarboxylic acids are removed by precipitation of their barium salts with alcohol, the greater part of the rest of the acids are then precipitated by passing CO_2 and addition of baryta under stated conditions; the diamino acids are precipitated from the decomposed carbamates by phosphotungstic acid—and the mono-acids separated by alcohol, leaving proline in solution.

Two determinations with the same preparation of serum protein gave fair agreement.

Results are given below for protein obtained by insolation of crepe after Spence and Kratz, and for serum protein—alcohol precipitated, after acid coagulation and amino-acids (obtained as above). No attempt was made to deal with the lead acetate precipitate owing to the very mixed nature of this product.

TABLE III.

	Rubber Protein. I		Serum Protein. II	
Quantity.	25 grs.	% of total Nitrogen.	50 grs.	% of total Nitrogen.
Total N. by Kj:	2.79*		4.34*	
Humin N. and some aspartic acid	.41	14.4	—	—
N. as dicarboxylic acid	.16	6.2	0.36	8.3
N. as diamino-acids	.11	3.9	0.29	6.6
Glycine	.047	1.7	.185	4.3
Other monamino-acids and hydroxy-proline	.212	7.6	.309	7.2
Proline	.276	9.9	.254	5.9
Non-carbamating	.15	5.36	.145	3.3

In order to test the completeness of separation—further determinations were made of the nitrogen in fractions by Van Slyke's method. This gave the following, percentages of amino-nitrogen.

TABLE IV.

	Rubber Protein % of N. in fraction by Kjeldahl.	Serum Protein % of N in fraction by Kj.
Dicarboxylic acids	99	102
Di-amino ,,	24	34
Mon-amino ,,	63	85
Glycine ,,	73	92
Proline ,,	69	75
Non-carbamating	73	trace.

* As prolonged purification was not carried out both the serum and rubber proteins contained a fair amount of ash. This explains the fact that the N. content is lower than usual.

The amino-acid solution.

Preliminary determinations were made with the mercury-acetate solution in Sample IV of Table I. These gave :--

TABLE V.

		% of
N. by Kjeldahl	... .53	grs. total N.
Amino N. by Van Slyke	... .23	„ or 43%
Amide and NH_3, N	... .14	„ „ 25%
Diamino N.	... .03	„ „ 6%

An attempt was made to effect further separation by the carbamate method.

TABLE VI.

Total Nitrogen by Kjeldahl (4000 ccs solution)		17.4 grs.
Amino Nitrogen by Van Slyke	...	8.4 = 18.2%
Nitrogen as NH_3	...	3.3 = 19.0%
Amide Nitrogen	...	1.3 = 7.5%

The whole was hydrolysed by boiling with dilute acid and warmed in vacuo with very slight excess of $Ba(OH)_2$ till NH_3 ceased to be evolved—then treated as the protein above.

		Nitrogen by Kj.		% of total Nitrogen in each fraction by Van Slyke.
		grs.	%	
Dicarboxylic acids	...	1.68	9.7	73
Diamino acids	...	1 55	8.9	31
Monoamino etc.	...	1.98	11.4	88
Glycine	...	2.58	14.6	35
Proline	...	.20	.86	77
Non-carbamating	...	1.55	8.92	39

The Van Slyke figures make it perfectly clear that nothing like a complete separation into groups has been achieved; further a great nitrogen loss has taken place—on the other hand it appears not unreasonable to assume that the figures are sufficiently accurate for the purpose stated above, viz. to ascertain whether any unusually large quantities of any one group exist. This has not been found to be the case.

The writer at any rate feels that further time spent along this line cannot be justified in the present state of our knowledge of latex. It will be noted that no discussion of the reason for the low nitrogen content of rubber has been undertaken; this must await a better method of separation than that of insolation.

Summary.

1. The distribution of nitrogen among the proteins, albumoses, amino-acids and amides has been investigated and found to be what might be expected from normal metobolic processes.

2. The constitution of the proteins by groups of amino acids, and the distribution of nitrogen in the amino acids themselves has been investigated, and as far as the results obtained can be accepted as giving a true picture, no unusual features are presented.

References.

1. Belgrave and Bishop ... M. A. J. XI. No. 12 p. 371.
2. Freundlich and Hauser ... India Rubber Jrn. LXIX. No. 17. p. 653.
3. Whitby ... Plantation Rubber.
4. Osborne, Wakeman and Leavenworth ... Jn. Biol. Chem. LIII p. 411
„ „ „ XLIX p. 63
5. Vickery ... Jn. Biol. Chem. LX p. 647.
6. Kingston and Schryver ... Biochemical Journal XVIII No. 5 p. 1070.

NOTES ON MISCELLANEOUS INSECTS IN 1924.

By B. A. R. Gater.

THE following notes of observations made on some of the insects which passed through the laboratory during the year 1924 are supplementary to the annual report for that year, and include details which could not be incorporated therein.

Little is known of the economic insects in Malaya, and many of the groups are still almost unknown systematically. Hence large numbers of insects hitherto unrecorded in this country are found every year, and in many cases, especially among the smaller insects, new species are found. Some of the insects recorded as of economic importance, i.e., which have been found damaging plant or other material, are present in small numbers only, and constitute very minor pests. On the other hand such insects may increase if suitable conditions arise, and they may be imported into other countries without their natural enemies, in which case they have every chance of becoming serious pests. These notes are published from the point of view of general interest in the occurrence and distribution of species, and as a guide to other countries in regard to insects which might be brought in from Malaya. In some cases considerable damage was caused in this country and the notes will therefore be of interest to Field Officers and Planters, giving some idea of what they may expect if the crops mentioned are planted in their districts.

A small consignment of brazil nuts was sent to this laboratory for examination, and showed the presence of numerous borers, all of which, however, cannot be considered as primary. The Platyrrhinid *Araecerus fasciculatus*, de Geer was present in some numbers, and the Tenebrionid *Alphitobius laevigatus*, F. was also present. Three small moths emerged from the sample : *Setomorpha rutella*, Zell. (Tineidae) *Decadarchis leucopogon*, Meyr. (Lyonetiadae) and *Labdia stibogramma*, Meyr. (Cosmopterygidae). The Gelechiad, *Stegasta variana*, Meyr. was found feeding on the leaves of this plant in the field. The latter has been previously recorded on groundnut and *Cassia* sp.

The occurrence on coconuts of *Promecotheca cumingi*, Baly, was noted some years ago by Burkill in Malacca. The palms were badly attacked over a considerable area, but the beetle apparently died down after a time. It has not been found since that time in the Malay Peninsula, although common in Borneo and the Philippines. On a recent visit to Labuan coconuts were found to have been damaged by two Hispinids, which have since been determined as *Plesispa reichei*, Chap. and *Promecotheca cumingi*. The latter was determined as *Promecotheca* sp. in the laboratory and the specimens were compared with specimens of *cumingi* in the Raffles' Museum, Singapore, which had

been identified by Dr. Gestro, and were found to be similar in all respects. From Burkill's description of the damage to palms in Malacca it appears that it was much more serious than is usually associated with this insect in the Philippines, and a watch should be kept for it on palms in Malaya. Unlike *Plesispa reichei* it damages mature palms and the larva is a true miner.

Kapok has been planted as a pure crop at the Serdang Experimental Plantation, and although this plant is to be found growing near almost every Malay village throughout the country, it has suffered severely from pests. *Hypomeces squamosus* is perhaps the most serious leaf-eating insect, but another Curculionid, *Alcides leeuweni* Hellr. is serious in some cases. In Java it has also been recorded on cacao. Eggs are laid singly inside the young green shoots, a longitudinal slit being grawed out by the female for the purpose. They hatch in three days and the larva appears to feed for three or four months before a quiescent period of three days occurs. At the end of this period an exit hole is made and the larva pupates inside the stem. The pupal stage lasts from 8 to 12 days, but the adult remains within the stem for 4 to 7 days before making its way to the exterior. Adults have been observed to begin gnawing the tender shoots about a week after emerging. Serious damage sometimes occurs if these weevils are numerous, although they appear to attack the weak rather than the vigorous trees.

A Noctuid caterpillar which has been identified as *Beara* sp. attacks the leaves of kapok to some extent, but it is at present of minor importance. The pupal period is 8 days. The species is not represented in the British Museum. Another leaf eating caterpillar is *Dasychira mendosa*, Hbn. (Lymantriidae) which is brown in colour with tufts of yellow hair on the dorsal segments. Pupation takes place a day after the cocoon has been completed, and lasts for five days. At present this is a minor pest only.

The green semi-looper caterpillars of *Anomis flava*, F. which has been known for some time as a minor pest of cotton, were found damaging roselle on several occasions. The pupal period is 6 to 7 days.

On two occasions bananas were reported to have been damaged by a Chrysomelid of the sub-family Eumolpinae, *Nodostoma* sp. This small brown beetle feeds on the epidermis of the young leaves, but does not appear to be serious. The species is unrepresented in in the British Museum. The butterfly, *Amathusia phidippus*, L. which is usually found on coconuts, was taken and bred out on banana leaf.

Maize was badly attacked by *Pyrausta salentialis*, Snell. the larvae being found in large numbers boring in the young shoots, flowers and unripe cobs. Sweet varieties of maize imported from other countries appear to be particularly susceptible to the attacks of

this insect, whereas the common native varieties may be seen growing close to and suffering no damage. *Cnaphalocrocis medinalis*, Guen. which is an occasional pest of padi, was found on maize and was bred out normally.

Chilies were attacked by *Anomala pallida*, F. and *Amsacta lactinea*, Cram. (Arctiidae) The grubs of the former attacked the roots, causing considerable damage, while the caterpillars of the latter fed on the shoots and the bases of the fruits, rendering them quite unfit for market. Only the green fruits were attacked but the large excavation made by the larvae, exposing the young seeds, caused the fruits to rot before they were ripe. This insect has also been recorded on tea and derris.

Croton leaves were badly eaten on several occasions by the larvae of *Amyna punctum*, F. (Noctuidae). The larva, which is a semi-looper, is about 27 m/m long and white to yellow in colour. Two irregular shaped black or dark brown fasciae are situated on the sides of the segments except the last; a short hair arising from the broadest portion of the lower fascia on each segment. A large stellar patch of the same colour is situated on the dorsum of each segment, surrounded by four dark spots from the centre of which arise single stout hairs. This pest is very prevalent and spraying had to be done repeatedly to keep it under, since it entirely defoliated the plants.

Another semi-looper caterpillar which was fairly prevalent was *Platyja umminea*, Cram. which attacked soursop. The larva is over 7 c/m in length when full grown, and of a dull slate-brown colour. Pupation takes place in folded-up leaves on the plant, the pupal stage lasting for 9 to 12 days. Soursop was also commonly attacked by the larvae of *Papilio agamemnon*. L.

Dadap (*Erythrina lithosperma*) was severely damaged by the boring caterpillars of *Terastia meticulosalis*, Guen. and repeated cutting back seemed to have little beneficial effect. The larva, which is white with a brown head, and has a number of brown papillae on the body from each of which arises a short hair, bores into the young green shoots, which wither and die back. Evidence of the presence of the caterpillar is also given by masses of excreta protruding from the stems. Eggs are laid in the axils of the leaves and pupation takes place in a strong silken cocoon within the stem. In one case pupation was observed to take place in the soil, the larva spinning its cocoon inside an earthen cell. *Erythrina indica* suffered slightly from *Agathodes ostentalis* Hbn. the caterpillars of which feed on the leaves. The full grown larva is about 25 m/m long, and is pale green in colour with an orange coloured head. A blue-green line may he seen running along the back and the spiracles are ringed with black.

The fruits of rambutan (*Nephelium lappaceum*) were damaged by *Dichocrocis punctiferalis*, Guen. (Pyralidae) the larvae feeding on the seeds and pupating in the soil. The leaves of this tree were eaten by the larvae of the Noctuid *Ischyja manlia*, Cram.

A fruit fly new to the collection, *Dacus cucurbitae*, Coq. was discovered on cucumber and luffa. The eggs were inserted under the skin of the fruits, the larvae boring in all directions and spoiling the fruit for consumption. When full-grown the larvae leave the fruit and enter the soil, pupating just under the surface. This is a serious pest of cucurbits and prompt action should be taken as soon as the maggots are found. All infected fruits should be picked at once and burned.

Crucifers were damaged by several insects, notably by the Pyralids *Crocidolomia binotalis*, Zell. and *Hellula undalis*, F. the latter being rather more common. The larvae of the first-named insect eat the flowers and young shoots, while the larvae of the latter appear to feed on any portion of the plant, and on one occasion were found boring into the midribs of the leaves.

Beans were attacked by *Lamprosema indicata*, F. (Pyralidae) the larvae of which feed on the leaves, and by *Tirathaba rufivena*, Walk, the larvae of which fold the leaves and feed inside. Parasites were found to attack the larvae of both these moths. *Tirathaba rufivena* is interesting because Mr. H. W. Simmonds writes me that he has reared this species from coconut spathes in Fiji, whereas the coconut Pyralid in Malaya is a species of *Tirathaba* allied to *trichogramma*, Meyr. which has not actually been determined. The two moths resemble each other somewhat, and it has been suggested that the species near *trichogramma* is merely a local race of *rufivena*, but in addition to differences in the adults the larvae are different.

Among other insects recorded during the year the following may be mentioned :—

Nygmia similis, Moore and *Nygmia* sp. No. 1057, on China-wood oil trees ; *Euthalia garuda*, Moore on cashew nut ; *Margaronia caesalis*, Walk on bread fruit : *Asota caricae*, Boisd. (Arctiidae) on Ngai camphor ; and the coconut skipper. *Hidari thrax*, Hbn. on bamboo.

Parasites.—Control by the importation of parasites is becoming more and more general as the study of parasitism and distribution advances. Several enquiries on the parasites of various pests have been received by the Entomological Laboratory during the year, and it is thought that the publication of a note of the parasites recorded during the year would be of some interest. Malaya is very rich in insect parasites, and it is possible to obtain quantities of material which might be used elsewhere. Unfortunately the vast majority of the parasites remains unidentified, but the table given below will give some idea of the available insects of this type. Only those hosts which have been definitely identified are shown, many of the batches received having been so well parasitised that identification was not possible.

PARASITES REARED IN 1924.

Host.	Stage attacked	Record No.	Remarks.
COCCINELLIDAE—			
Chilomenes 4-plagiata, Swartz -	Pupa.	1381	Chalcidoid.
HISPINAE—			
Plesispa reichei, Chap.-	Egg.	1855	Chalcidoid. See special Bulletin No. 34.
,, *nipa*, Maulik-	,,	1854	Chalcidoid.
DYNASTINAE—			
Oryctes rhinoceros, L.-	Larva.	1452†	Pupal period 8 days. Sarcophagid.
,, ,, -	,,	1460†	Sarcophagid.
,, ,, -	,,	1686†	
PENTATOMIDAE—			
Scotinophara coarctata, F. -	Egg.	960	Chalcidoid. See M. A. J. Vol. 12 No. 4.
Scotinophara coarctata, F. -	Nymph.	1234†	
COREIDAE—			
Leptocorisa sp. -	Egg.	1852	Chalcidoid.
,, -	,,	1857	,,
Leptocorisa acuta, Thunb. -	Egg.	1917	Chalcidoid.
PAPILIONIDAE—			
Papilio agamemnon, L.	Larva.	1958	112 from one larva. Braconid.
AMATHUSIIDAE—			
Discophora necho, Fldr.	Pupa.	1934	20 from one pupa. Tachinid.
Amathusia phidippus, L. -	Larva	1195	Tachinid.
HESPERIIDAE—			
Chapra mathias, F. -	Larva	1790	Tachinid. *Thelaira* sp. ?
,, ,, -	,,	1850	Braconid.
,, ,, -	,,	1935	Chalcidoid.
Hidari thrax, Hbn. -	,,	958	Tachinid.
,, ,, -	,,	1204†	Pupal period 13 days. Sarcophagid.
Erionota thrax, L. -	,,	1859	Braconid. *Apanteles* sp. ?

PARASITES REARED IN 1924.—(contd.)

Host.	Stage attacked	Record No.	Remarks.
NOCTUIDAE—			
Amyna punctum, F.	Larva.	1238	Tachinid.
Spodoptera pecten. Guen.	Egg.	1321	Chalcidoid.
LYMANTRIIDAE—			
**Dasychira grossa*, Pag.	Pupa.	1931	Tachinid.
Nygmia scintillans, Walk.	Larva	1412	22 from one larva. Chalidoid. Pupal period 6 days.
Nygmia scintillans, Walk.	„	1418	7 from one larva. Braconid.
Nygmia scintillans, Walk.	„	1445	
SPHINGIDAE—			
Acherontia styx, Westw.	Egg.	1592	69 from 3 eggs. Chalcidoid.
SATURNIIDAE—			
Attacus atlas, L.	Egg.	1044	Chalcidoid.
„ „	„	1106	„
„ „	„	1803	„
PYRALIDAE—			
Psara bipunctalis, F.	Pupa.	1591	Ichneumonid.
„ „	Larva.	1932	Braconid.
„ *stultalis*, Walk.	„	1403	43 from one larva. Braconid.
Psara submarginalis, Swnh.	„	1595	Adult not reared. Hymenoptera.
Lamprosema diemenalis, Guen.	„	914	7 to 8 from one larva. Braconid. Pupal period six days.
Lamprosema diemenalis, Guen.	„	1522	5 to 9 from one larva. Braconid. Pupal period 8 days.
Lamprosema diemenalis Guen.	„	1523	Pupal period 6 to 8 days. Braconid.
Lamprosema diemenalis, Guen.	„	1687	Pupal period 8 days.
Sylepta derogata, F.	„	1320	Chalcidoid.

PARASITES REARED IN 1924.—(contd.)

Host	Stage attacked	Record No.	Remarks.
PYRALIDE—(contd).			
Sylepta derogata, F. -	Larva.	1759	Pupal period 8 days; Braconid ; hyperparasitised.
,, ,, -	,,	1908	13 from one larva. Braconid.
,, ,, -	,,	1944	10 to 11 from one larva. Braconid. Pupal period six days.
,, ,, -	,,	1951	10 to 11 from one larva. Braconid.
Caprinia conchylalis, Guen. -	,,	1708	19 from one larva. Pupal period 8 days. Braconid.
Chaphalocrocis medinalis, Guen. -	,,	966	
Tiratkaba sp. nr. trichogramma, Meyr.	,,	1483	Tachinid.
,, -	,,	1504	Ichneumonid. *Anilasta* sp.?
,, -	,,	1515	,, *Camptolex* sp.?
GELECHIADAE—			
Stegasta variana, Meyr.	Larva.	1541	Adult not reared. Hymenoptera.
GRACILLARIADAE—			
Stomphastis plectica, Meyr. -	Pupa.	1542	Proctotrypid ?
LYONETIADAE—			
**Phyllocnistis citrella*, Stt. -	Pupa.	1537	2 from one pupa. Chalcidoid.
**Phyllocnistis citrella*, Stt. -	,,	1538	Adult not reared. Hymenoptera.
AGROMYZIDAE—			
**Agromyza sojae*, Zehnt. -	,,	1373	Chalcidoid.
	,,	1379	

*Identification provisional only.
†Parasitism uncertain.

In addition to the above lists of parasites the following predatory insects were observed :—

The Syrphids *Ischiodon scutellaris*, F. and *Paragus serratus*, F. —the Noctuid *Eublemma rubra*, Hamps. and an unidentified Lycaenid whose larvae were predaceous on Coccids—the Coccinellids *Alesia discolor*, F., *Chilocorus politus*, Muls., *Chilomenes 4—plagiata*,

Swartz, and *Coelophora inaequalis*, F. The parasitic and predatory enemies of *Artona catoxantha* are not mentioned, being fully dealt with in another paper. The thanks of the writer are due to Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, and to the Systematic Specialists of the British Museum, for the identification of species.

Received for publication 19th March, 1925.

PROGRESS REPORT ON A CAMPAIGN AGAINST RATS IN KRIAN DISTRICT. NOVEMBER 15th, 1924—MARCH 31, 1925.

By F. W. South and F. Birkinshaw.

ON the suggestion of the Chief Secretary to Government a special campaign against rats was commenced on November 15th, 1924 in a defined portion of the irrigated padi area in Krian. This campaign had three objectives in view. It was intended to destroy as many rats as possible before the padi harvest. It was also intended to arouse among local padi cultivators a greater and more practical interest in rat destruction by demonstrating the value of concerted and sustained measures for this purpose. Finally it was expected to provide for future use information regarding the best methods of rat control.

Organisation.

Area.—The area selected for a commencement was that enclosed by the Province Wellesley boundary on the North, the Parit Buntar—Bagan Serai road on the East, the Bagan Serai- Kuala Kurau road on the South and the coast between Kuala Kurau and the Province Wellesley boundary on the West. This area is approximately 30,000 acres in extent and comprises some of the best padi land in Krian District. It is divided roughly into halves by that part of the main irrigation canal which runs somewhat diagonally northwest from Bagan Serai to Tanjong Piandang.

Staff.—Two European Special Officers were temporarily appointed for the work. Mr. Lindsay Vears was placed in charge of the area south of the main canal on November 15th and Mr. A. E. Taylor was appointed to be in charge of the area north of the canal on December 1st. Both Special Officers worked under the direction of the Agricultural Field Officer, Perak North.

Methods.—Before the campaign started the co-operation of the District Officer was obtained. He arranged for the active assistance of the Penghulus in the area and it was agreed to offer prizes to such Ketuas and others as should be recommended by the District Officer for good results obtained by their aid.

The Executive Engineer, Krian, agreed to assist by carrying out with his own staff the work of rat destruction affecting the banks of the canals and distributaries of the irrigation system. The arrangement was that the Department of Agriculture should provide the material required and, if necessary, the money for the payment of additional labour, and that officers of the Agricultural Department would demonstrate the methods to be employed.

The Special Field Officers were made responsible for encouraging and assisting all cultivators in the area under their charge to destroy

rats by the use of poisoned baits, by trapping and by organised hunting. The necessary poisons and traps were supplied by the Department of Agriculture free of charge. These officers were also instructed to arrange convenient centres at which rewards, at the rate of one cent a tail, could be paid two or three times a week for all rat tails brought in.

Experiments were to be undertaken as opportunity offered with calcium cyanide dust for the destruction of rats in holes in the banks of canals or distributaries, or in the "batas" of the padi fields or elsewhere. This powder is blown into the rat holes from a powder gun. There it evolves hydrocyanic acid gas which quickly proves fatal to any rats in the underground run. Calcium cyanide thus acts in much the same manner as does carbon bisulphide, the use of which is described in Bulletin No. 5 of the Department of Agriculture, F.M.S. Carbon bisulphide has given very satisfactory results in the past, but is now unobtainable, since shipping companies refuse to carry it because it is extremely inflammable. It is hoped, therefore, that calcium cyanide may prove a convenient substitute.

Summary of Work Done and Results Obtained.

1. *Poisons.*

(*a*) *Sodium arsenite.*—Six cwt. of this poison was supplied and was distributed to all cultivators throughout the area by the Ketuas. The common Malay method of using a dead grasshopper as bait and inserting some of this poison into its stomach proved very successful, but the quantity of grasshoppers used caused the price of the dead insects to jump from 20 to 40 cents a hundred in a very short time.

Various other mixtures were experimented with and of these the following appears to have been the most successful:—

Sodium arsenite	...	1 part by volume
Rice polishings	...	½ „ „ „
Dried fish or prawn	...	1 „ „ „

These were mixed with enough coconut oil and water to make the mixture bind. It was then rolled into small balls and placed here and there on the batas of the padi fields.

(*b*) *Barium carbonate.*—When work started no supplies of this poision were available but a consignment previously ordered arrived in January and of this 820 lb. were sent to Krian, for distribution to padi growers as required.

The use of these poisons has doubtless accounted for the death of a large number of rats, but no exact figures can be given, because in the returns of tails collected no record has been kept of the cause of death, and also because, in all probability, a certain proportion of the rats killed are not found. Cultivators are prone to be somewhat sceptical of the utility of the poisons because the dead rats are

seldom recovered by the man who puts down the poison. Both poisons are somewhat slow acting, so that the rats often run a considerable distance before they die.

(*c*) *Calcium cyanide.*—A supply of 20 tins each of 5lb. was obtained for killing rats in their holes. The method of using the poision has already been described. At first the necessary powder guns were not available but later one was obtained and a Malay was trained to use it. The preliminary experiments with it proved successful. In February 12 more pumps were obtained for use by the P.W.D. on the banks of the irrigation system. It was found however, that contrary to expectation, rat holes in the canal banks were not very numerous, so that opportunities for using the cyanide were limited. Further work with this poison is contemplated during the year, when a small number of Malays will be trained to use it.

2. *Traps.*—The kind of trap used was a simple form of break back trap, consisting of a wire spring mounted on wood. Four thousand of these were obtained and 500 were handed over to the Executive Engineer. Nearly the whole of the remainder were distributed free of charge to padi cultivators who have shown more interest in this method of killing rats that in any other.

3. *Organised Hunting.*—Very little use has so for been made of this method.

4. *Payment of Rewards for Tails.*—Early in the campaign it was realised that many Malay padi growers did not take kindly to the idea of bringing in rats tails for a reward. In several instances Ketuas have carefully recorded the number of rats killed by padi-growers, but have refused to present tails and claim the reward. It was felt that this reluctance to accept rewards might affect the success of the campaign. Consequently the Inspector of Schools was approached and his permission was obtained to utilise the schools for the payment of rewards for tails brought in by the scholars. This proved a success. The boys probably began by bringing in a few tails from rats caught by their fathers, but they soon began rat catching themselves, traps being supplied to the schools for this purpose. Thirteen schools assisted in this way and were responsible for 28,910 tails, a very creditable total. The valuable assistance of the masters of the schools is much appreciated by the Department. As the campaign progressed the Malays themselves became less reluctant to claim the rewards and Ketuas brought in a certain number of tails.

Results.

The destruction of rats proceeded steadily until the end of February when it practically stopped because all the available labour was fully occupied in reaping the harvest. On February 23rd Mr. A.E. Taylor resigned and it was decided not to replace him, as a revised scheme of organisation for future work based on the experience gained, was in process of formation. Mr. Lindsay Vears was left in charge of such work as could be done throughout the whole of the area during March.

The total number of rats reported as killed between November 15th 1924 and March 31st 1925 in the area of the campaign was 71,092. This was made up as follows:

Tails collected by Schools	28,910
Tails brought in by Ketuas	16,107
Tails collected by the P. W. D.	2,351
Rats reported killed by Ketuas	23,724
	71,092

The last item represents accounts kept by Ketuas of rats reported to them as killed, but for which no rewards were claimed. No reasons are, however, known for doubting the accuracy of these accounts. The total probably does not include all the rats killed by poison of which a proportion were probably not found, nor does it include litters of young that may have died after the destruction of their parents. This result was considered sufficiently satisfactory to justify the continuation of the campaign throughout the remainder of this year and its extention to include practically the whole of the irrigation area in Krian. There is little doubt that only a percentage of this number of rats would have been caught had the campaign not been inaugurated.

The campaign was started too late in the year to obtain full success in saving padi from damage, as a good deal of damage had been done to the growing crop before work started. It will be interesting to see the effect of the work done in reducing the damage to the next crop.

Apart from the number of rats destroyed, the campaign has achieved a satisfactory measure of success in its second objective, since it has undoubtedly aroused the interest of the padi growers in measures for the control of rats. It is hoped that continuation of the work will help to maintain this interest, more especially during the planting of the nurseries and the subsequent growing period of the next crop.

Valuable experience in the habits of rats and the methods of destroying them has been gained, but much remains to be learnt regarding their habits at different seasons of the year. Further experiments with different methods of trapping and poisoning will be undertaken. Special attention will be given to the use of calcium cyanide which should prove a serviceable poison, if opportunities for its use in large quantities can be found.

While this article was in preparation information was received that during the month of April the coolies employed by the P. W. D. had destroyed 16,454 rats of which the majority were caught by organised hunting.

Along the bottom of the banks of the water distributaries in Krian, between the banks themselves and the padi fields proper,

grows a strip about 6 or 8 feet wide of a rush, *Scirpus grossus* Vahl., known by the Malays as "rumput menderong." It was found that rats were sheltering in this in considerable numbers and were even building temporary nests in it. To destroy these the following method is employed. A length of about 30 yards of the rush is dealt with each time ; two or three coolies cut down all the weeds giving cover along the bank of the distributory, while two or three more coolies cut away the weeds in the padi field on the other side of the belt of rushes, so as to clear the land for a width of about 12 feet. After the cutting has started at the sides, one cooly at each end commences to cut the menderong itself. In this way the rats are driven along the belt of menderong, until only a small patch of cover is left. When the rats finally attempt to leave the cover they are killed by the coolies. Only a very few manage to escape. The coolies receive the usual reward of 1 cent per tail in addition to their wages.

This method is not so expensive as it might seem, because the weeds along the banks of the distributaries have to be cut in any case.

The method is rendered far more successful when the work of the coolies is properly organised and the Agricultural Department is much indebted to Mr. Grantham, Assistant Engineer Krian, for the attention he has given to this important point and the interest he has taken in the work.

Received for publication 10*th May* 1925.

MARKETING ROSELLE.

AS the cultivation of roselle in this country has been neglected of late, attention should be drawn to the fact that certain manufacturers both in the United Kingdom and America have of late addressed this Department on the subject of supplies of the fibre, shewing that they were anxious to know the possibilities of obtaining regular supplies and being placed in touch with growers.

The earlier attempts to cultivate this crop on a profitable basis did not meet with success in many cases, but at least two planters went so far as to manufacture rope and string which they found no difficulty in disposing of locally, and obtaining a fair profit. This method may be recommended when roselle is grown as a catch crop in young rubber, as was the case in the two above mentioned instances; but if the European or American markets are to be supplied, it is essential that a guarantee of supplies be forthcoming, and it is doubtful whether successful connections with manufacturers will be established unless this is done. The attitude of the planter has been that he required a guaranteed market over a period; of the manufacturer, that he required a guaranteed output—and a considerable one too—before he could consider the possibilities of using roselle. Between these two views, the cultivation of roselle languished and has practically died out.

The fact that manufacturers are interesting themselves in roselle is probably due to the continued rise in price of jute; and the time seems opportune for action, if roselle is to be established as an industry in Malaya, to place growers and manufacturers in touch on this subject.

From correspondence received from manufacturers, the use of roselle is placed in competition with Jute. The London price of jute on January 28th last for "Native First Mark" quality was £38-15-0 per ton. The total outturn of jute in British India in the season 1924 is estimated at 8,045,000 bales of 400 lbs. as against 8,472,000 bales (revised) in 1923 (including imports from Nepal).

Two samples of yarn prepared by a well known firm of Dundee manufacturers have recently been received by the Department. Sample No. 1 was made entirely of roselle fibre; sample No. 2 from three-quarters jute and one quarter roselle fibre. The firm in question comment as follows on these samples.

> "The quality of No. 1, though very hairy, is clean and strong and inclined to be brittle.. If this yarn was twisted in two or three ply, it would be extremely strong. It did not work well on the preparing machinery, being so strong and harsh it did not draw well, and was inclined to choke on the drawings. If it was a case of working in bulk, the preparing machinery could be altered to get over this to a large extent. I should think this would be a valuable fibre to anyone making twines.

In the No. 2 sample we found that this fibre did not blend very well with the jute. In the preparing, the jute was drawn easily while the fibre held and this, of course did not make level yarn, but if the price was sufficiently low it might tempt one to make further experiments in this line."

They conclude by stating that they would be glad to receive an offer of about five tons, so that they could really have a chance of experimenting.

A London firm to whom the Department of Agriculture forwarded a sample of roselle fibre grown on the Government plantations state that the fibre is not well introduced in London, and such being the case they would be pleased to receive small consignments of 5 to 10 tons, so that they can get it introduced to their various buyers ; and later they could probably arrange to give definite firm orders for a larger quantity spread over 3 to 6 months in advance.

In a previous communication, this Department had pointed out that growers were reluctant to cultivate roselle as they had been unable to obtain forward orders over a period of one or two years, but if this could be arranged, it was possible that planters would cultivate the crop.

In reply, the firm in question state :—

"We do not think that buyers will entertain placing an order for one or two years, in view of the somewhat violent fluctuations that have taken place recently in hemps and fibres of this description. The fibre should, however, fetch £25 to £30 per ton c.i.f. United Kingdom and naturally, if the market is better, it will probably fetch more, but we think this is a fairly stable market value on which you could rely.

The fibre should be pressed in bales, 3 to 4 cwt. each would be a suitable size, or not less than 2 cwt. if your presses are smaller."

The Department of Agriculture will be pleased to give further details on application, of such correspondence as has been received.

D. H. G.

Received for publication 12th May 1925.

PRICE LIST OF PLANTING MATERIAL OBTAINABLE FROM THE DEPARTMENT OF AGRICULTURE, F.M.S. & S.S.

THE undermentioned planting material is produced mainly at the Experimental Plantation, Serdang, and small stocks of such material are usually available for sale.

A register of growers who are able to supply large quantities of any particular material is kept in the Agriculturist's Office with the object of placing purchasers in touch with sources of supply.

Orders for planting material should be addressed to the Agriculturist, F.M.S. & S.S., Kuala Lumpur, and should be accompanied by a remittance to cover the material ordered.

It is advisable in the first instance that applicants for planting material enquire from the Agriculturist whether the material required is in stock before forwarding a remittance.

With a view to expediting the execution of orders, applicants are particularly requested to state their requirements in a separate letter and not to include them in correspondence dealing with other subjects.

The prices quoted below include packing charges and freight from Kuala Lumpur to any station on the Federated Malay States Railways.

B. B.

A. AGRICULTURAL PLANTS.

Food Crops.

Cow Pea	-	seed 50 cents per lb.
Maize	-	,, 20 ,, ,,
Pigeon Pea	-	,, 50 ,, ,,
Sweet Potatoes—		
Local	-	cuttings $1/- per 100
Gedang	-	,, ,,
New Jersey Red	-	,, ,,
Menesbodas	-	,, ,,
North No 3	-	,, ,,
Samar Big Yellow	-	,, ,,
Samarinda	-	,, ,,
Southern Queen	-	,, ,,
Victoria.	-	,, ,,
Sugar Canes—		
Malayan varieties	-	cuttings $2/- per 100
Java ,,	-	,, ,,

Tapioca—

Local White	- cuttings	$1/- per 100
,, Green	- ,,	,,
Aipin Valeuca	- ,,	,,
,, Mangi	- ,,	,,
Kapo	- ,,	,,
Mandioca Basioras	- ,,	,,
,, Creolinha	- ,,	,,
,, Sao Pedro Treto	- ,,	,,
Manis	- ,,	,,
Sipin Mangi.	- ,,	,,

Yams—

Greater	- tubers	25 cents per lb.
Lesser.	- ,,	,, ,,

Fruits.

Avocado Pear	- seedlings in bamboo pots	.40	cents each.
Bananas (varieties)	- suckers	.25	,, ,,
Blimbing	- seedlings in bamboo pots	.40	,, ,,
Brazil Cherry	- ,, ,,	.40	,, ,,
Brazil Nut	- ,, ,,	.40	,, ,,
Bullock's Heart	- ,, ,,	.40	,, ,,
Carambola	- ,, ,,	.40	,, ,,
Chiku	- ,, ,,	.40	,, ,,
Durian	- ,, ,,	.40	,, ,,
Guava	- ,, ,,	.40	,, ,,
Jack Fruit	- ,, ,,	.40	,, ,,
Lemon	- ,, ,,	.40	,, ,,
Lime	- ,, ,,	.40	,, ,,
Malay Apple	- ,, ,,	.40	,, ,,
Mangosteen	- ,, ,,	.40	,, ,,
Orange	- ,, ,,	.40	,, ,,
Pineapples (varieties)	- suckers	.10	,, ,,
Pomelo	- seedlings in bamboo pots	.40	,, ,,
Pulasan	- ,, ,,	.40	,, ,,
Rambai	- ,, ,,	.40	,, ,,
Rambutan	- ,, ,,	.40	,, ,,
Ramnia	- ,, ,,	.40	,, ,,
Rokam	- ,, ,,	.40	,, ,,
Soursop	- ,, ,,	.40	,, ,,
Sugar Apple	- ,, ,,	.40	,, ,,
Tamarind	- ,, ,,	.40	,, ,,
Water Lemon (Passiflora laurifolia)	- ,, ,,	.40	,, ,,

Beverages.

Coffee (varieties)—

Liberian	- seed	$1/- per lb.
Robusta.	- ,,	,, ,,

Fixed Oils and Fats.

African Oil Palm	-	seed $5/- per 1000
,, ,,	-	seedlings .25 cents each
Castor Oil	-	seed .50 ,, per lb.
Gingelly	-	,, .50 ,, ,,
Groundnuts (varieties)	-	,, .20 ,, ,,

Essential Oils.

Citronella Grass	-	cuttings $2.50 per 1000
Geranium ,,	-	,, $2.50 ,,
Lemon ,,	-	,, $2.50 ,,
Patchouli ,,	-	plants $10/- per 100
Vetiver ,,	-	cuttings $2.50 ,, 1000

Fibre Plants.

Bimlipatam Jute	-	seed $1/- per lb.
Kapok	-	,, .25 cents per lb.
Manila Hemp	-	suckers .20 ,, each
Mauritius Hemp	-	bulbils $1/- per 100
,, ,,	-	suckers $2/- ,,
Roselle Fibre	-	seed $1/- per lb.
Sisal Hemp	-	bulbils $1/- ,, 100
,,	-	suckers $2/- ,, ,,

Drugs.

Ipecacuanha	-	cuttings .10 cents each.
,,	-	plants .40 ,, ,,

Spices.

Pepper	-	plants .20 cents each.
Vanilla	-	cuttings .10 ,, ,,

Dyestuffs & Tanning Materials.

Annatto	-	seed $1/- per lb.
Gambier	-	,, $1/- ,,

Fodder Grasses.

Australian Blue Couch	-	cuttings $2.50 per bag.
Bermuda Grass	-	,, 1.50 ,,
Carpet Grass	-	,, 1.50 ,,
Dallis Grass	-	,, 1.50 ,,
Guinea Grass	-	,, 2.50 per 1000
Mauritius Grass	-	,, 2.50 per 1000
Napier Grass	-	,, 2.50 per 1000

Cover Crops.

Calopogonium mucunoides	-	seed .50 cents per lb.
Canavalia ensiformis	-	,, .50 ,, ,,

COVER CROPS—*(contd).*

Centrosema Plumieri	-	seed	.20 cents per lb
,, pubescens	-	,,	.50 ,, ,,
Crotalaria anagyroides	-	,,	.50 ,, ,,
,, usaramoensis	-	,,	.50 ,, ,,
Mimosa invisa	-	,,	.50 ,, ,,
Tephrosia candida (Boga Medeloa)	-	,,	.50 ,, ,,
,, Hookeriana var. amoena	-	,,	.50 ,, ,,
Vigna oligosperma	-	cuttings	$1.50 per bag.

ORNAMENTAL AND SHADE TREES.

Casuarina equisetifolia	-	plants	.40 cents each.
Cassia grandis	-	,,	.40 ,, ,,
,, multijuga	-	,,	.40 ,, ,,
Jacaranda	-	,,	.40 ,, ,,
Peltophorum ferrugineum	-	,,	.40 ,, ,,
Poinciana regia	-	,,	.40 ,, ,,
Rain Tree	-	,,	.40 ,, ,,
Spathodea campanulata	-	,,	.40 ,, ,,

B. HORTICULTURAL PLANTS.

Shrubs (*a*) bushes	-	plants	.25 cents each.
(*b*) standards	-	,,	.50 ,, ,,
Climbers	-	,,	.25 ,, ,,
Palms	-	,,	.50 ,, ,,
Ferns	-	,,	.50 ,, ,,
Cannas (varieties)	-	roots	.10 ,, ,,
Flower Seeds	-	Arrangements have been made with Messrs John Little & Co., Ltd., Kuala Lumpur for the distribution of these seeds, to whom all applications for same should be sent direct.	
Vegetable Seeds	-		

Planting material other than that mentioned in this list will be quoted on application, providing material is available for distribution.

Received for publication, 31st May, 1925.

Publications of the Department of Agriculture.

The following publications, except those out of print, may be obtained on application to the Office of the Secretary for Agriculture; and the Malay States Information Agency, 88, Cannon Street, E.C. London.

A remittance to cover the cost should accompany applications; otherwise the Journals will be sent by post, Cash on Delivery, where that system is in force.

1. The Agricultural Bulletin F.M.S.

Vols. I—IV	(1913-16)	VIII & IX (1920-21)	price $5.00 per volume.
Vol. V	(1917)	Nos. 1, 2, 3, 5 & 6	„ 2.50 per set.
„ VI	(1918)	„ 1, 7, 8 & 12	„ 2.00 „
„ VII	(1919)	„ 2—6	„ 4.50 „

2. The Malayan Agricultural Journal (continuing the Agricultural Bulletin). Published monthly.

Vol. X (1922)	Price $5.00 per volume.
„ XI (1923)	Price $5.00 per volume or 50 cents per single number.
„ XII (1924)	„ „ „ „

Back numbers of Vols. I—X will not be sold singly.

3. The Handbook of Malayan Agriculture, price $1.00.

Current numbers of the Malayan Agricultural Journal and the Handbook may be purchased at the Railway Bookstalls and Branches of Messrs. The Federal Rubber Stamp Co.

4. *Special Bulletins.*

1. Notes on *Termes Gestroi* and other species of Termites found on Rubber Estates in the Federated Malay States, by H. C. Pratt, Government Entomologist, 1909, 20 cts.
2. Root Diseases of *Hevea Brasiliensis*, by W. J. Gallagher. C
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